AIRFLOW CHANGES IN MULTIPLE-FAN SYSTEMS

BY D. S. KINGERY AND F. F. KAPSCH

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AIRFLOW CHANGES IN MULTIPLE-FAN SYSTEMS[1]

by

D. S. Kingery[2] and F. F. Kapsch[3]

SUMMARY AND INTRODUCTION

The practice of using two or more main ventilating fans is common at large coal mines throughout the coal-mining industry. To assure adequate and efficient ventilation at many mines, such multiple-fan systems are necessary. The hazards associated with interrelated ventilating currents if a fan fails are controversial, and to date little effort has been made to study this specific problem and to determine corrective measures.

The obvious questions are:

1. Is there a hazard?

2. Under what circumstances does it exist?

3. How serious is it?

4. What are corrective measures?

Most members of the mining fraternity agree that reduced quantities of air and changed airflow patterns introduce potential hazards, especially where gaseous conditions exist when mechanized methods are used in concentrated mining. The seriousness of the hazard depends on the ease with which methane accumulates in face areas or haulage roads, the quantity of methane in worked-out areas, and the extent to which reversed air currents interfere with escape and recovery operations after mine fires or explosions.

These studies cover three mines and give the distribution of air for the specific conditions shown. Each mine probably has somewhat different airflow-pressure relationships between fans. This depends on the number of fans, the

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distance between fans, whether or not fans are separated, and mine-development, operating, and ventilating practices.

This means that although there are general potentially dangerous conditions applicable to all multiple-main-fan ventilating systems, the degree of the hazard will be determined largely by individual systems, operating practices, and the extent to which methane can become involved.

It is important that mine managements study their ventilating systems and determine what distribution of air will result if a fan fails. It is also necessary to prepare a plan of action that can be immediately carried out after a fan stops to assure the maximum safety of the men and the mine.

Installing self-closing doors to block air from intaking through return exits is an important safety precaution. Separated returns may also be desirable when two or more fans are used, since they establish the direction of airflow and permit better control over the air. Such separations are usually accessible sliding or swinging doors that allow enough leakage to prevent dead ends and can be opened if desirable.

This report endeavors to illustrate and discuss important factors associated with certain multiple main-fan ventilating systems of bituminous coal mines. The airflow patterns illustrated show airflow distribution that would occur if a fan fails. These airflow patterns were determined by the Federal Bureau of Mines electric analog[4/] and were based upon ventilation and absolute pressure surveys at the mines. A perfect airflow balance was not attempted, since the inconsistencies of air distribution were within error limits of survey data or analog results.

ACKNOWLEDGMENTS

The Federal Bureau of Mines acknowledges the assistance of those mining companies that cooperated with the Mine Ventilation Group and made this report possible.

POTENTIAL HAZARDS

The hazards in the following list are associated mainly with systems using connected returns and without doors to prevent air from intaking through return shafts.

1. A system using multiple intakes may, by natural distribution of air, develop neutral spots in intake aircourses.

2. Interconnected fans operate in combination; consequently, a sudden change in some section could adversely affect airflow in other sections. The seriousness of this condition may depend on local circumstances and the amount of methane liberated in the affected sections.

[4/] McElroy, G. E., A Network Analyzer for Solving Mine-Ventilation-Distribution Problems: Bureau of Mines Inf. Circ. 7704, 1954, 13 pp.

3. If a local mine explosion or fire changes the ventilation balance between fans, there is a greater possibility of reversed air currents, which may endanger the lives of escaping men and complicate recovery operations.

4. If one fan is stopped, the following conditions very often occur:

a. Airflow is reduced in certain sections.

b. Air is short-circuited from other sections.

c. Air is reversed in returns and possibly on haulage roads.

d. There may be flow from return aircourses to intake aircourses under specific conditions.

e. With reversed airflow in certain return aircourses, and dependent on the physical conditions of the aircourses and the amount of pressure loss through sections, section returns may also reverse direction and bring return air into active faces. This condition may develop when the returns of a single section or of connected sections flow to different fans and the returns are not separated.

f. Certain haulage roads may not be ventilated, and other haulage roads may be poorly ventilated.

These conditions may not occur in all instances and by themselves may not be considered hazardous; however, with other variables, such as operating conditions and practices and liberation of methane, they constitute potential dangers that the coal-mining industry should endeavor to eliminate or minimize.

MINE A

Figures 1 through 4 show the airflow adjustments at two fans of a large coal mine using four main fans. To simplify illustrations of airflow and ventilating-pressure adjustments, only the quantities of air actually ventilating the active working sections shown were included.

Normal Air Distribution With Two Fans Operating

The returns were not separated, and no provision was made to prevent intake through return shafts (see fig. 1).

Fan A was operating at 100,000 c. f. m. at 1.8 inches water pressure. The pressure-volume characteristic is shown.

Fan B was operating at 170,000 c. f. m. at 1.5 inches water pressure. The characteristic curves for fans A and B were different.

Airflow was induced by the combined fans from the fan B shaft intake and the slope intake near fan A to the main junction.

Normal air leakage was as shown. The north pillar section was ventilated with 50,000 c. f. m. and the south section with 55,000 c. f. m. Parallel returns with relatively low resistance were provided to fan A. Air traveled through the sections as shown in figure 1 and returned to both fans. The detailed flow to sections inby fan B is not shown. The pressure distribution is shown by the pressure gradient. Air flowed from fan B inlet to the main intersection, through the sections, and returned to fan B at 1.5 inches water pressure; air flowed from the fan A inlet to the intersection, through each section, through gob, bleeder, and main return to fan A, with a drop of 1.8 inches water pressure. This pressure gradient shows that the resistance factors for both intake and return aircourses from fan B were higher than for fan A because of shaft resistance and because there was one less intake entry and return flow was not completely parallel.

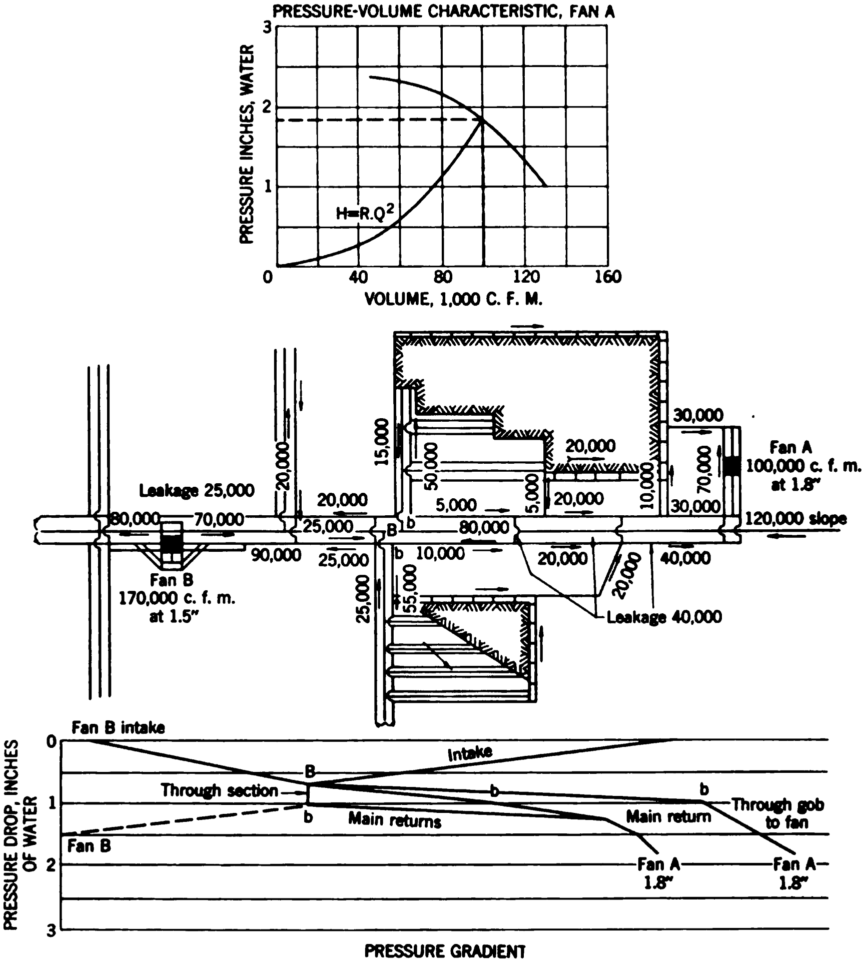

FIGURE 1. - Mine A–Normal Air Distribution With Two Fans Operating.

Air Distribution With Fan B Stopped

With fan B stopped, air continued to enter the fan B intake shaft; air flowed again to the main junction but at a reduced rate (see fig. 2). Air available to the north and south pillar sections was about half of that previously available. There also was an intake of 40,000 c. f. m. through the fan B return, which caused a reversed flow in the returns between the air shaft to the return side of the intersection. Return air from the sections, plus this 40,000 c. f. m. traveled the return system to fan A, as shown in figure 2. All sections inby fan B were short-circuited, as well as the haulage roads. Fan A then operated at 125,000 c. f. m. and 1.25 inches water pressure owing to the change in mine resistance. The pressure drops across the gob areas and bleeder entries were in the same direction as before. Probably no air would flow from returns to intake with this setup. The pressure drops were as shown by the pressure gradient, which shows that with reduced flow the drop along intakes was about one-fourth that which occurred with both fans operating; although the drop through the returns increased, the total mine drop was less.

Air Distribution With Fan A Stopped

With fan A stopped air continued to flow from intake sources to point B. The quantity of air available to ventilate the pillar sections was approximately the same as that with fan B stopped. Approximately 45,000 c. f. m. entered through the fan A return shaft. One split traveled the bleeder and gob of the north pillar section, and the other paralleled the intake flow from the slope. Intake air from fan B to the main junction was approximately as shown in figure 3.

The amount of leakage with such conditions is important and determines the amount of airflow available for sectional ventilation. The haulage road between section X intake and point B was neutral; however, there was no flow from return to intake aircourses. Sections inby fan B were ventilated by approximately 70,000 c. f. m. Fan B operated at approximately 190,000 c. f. m. and 1.1 inches water pressure. In the pillar sections the pressure was from the gob and bleeder entries toward the faces - a condition that could become hazardous.

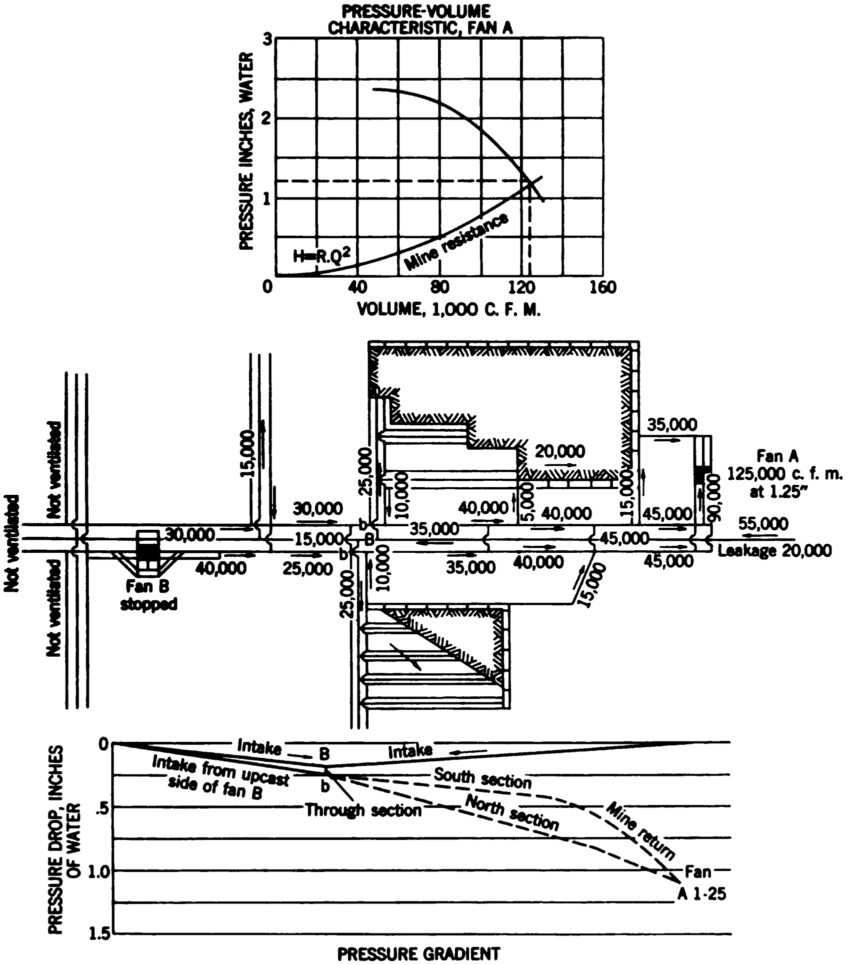

FIGURE 2. - Mine A—Air Distribution With Fan B Stopped.

Between the intake and return aircourses and from the intake slope and fan A return shaft to the intake and return side of the main junction, the difference in pressure was very slight. This means that airflow probably was sluggish, and if any openings existed between intakes and returns, such as leaky man doors and splits for ventilating shops and substations, return air, depending on the condition of the returns, probably would intermingle with intake air. With large gob areas open to the returns, this situation could, during an extended fan stoppage, permit air-gas mixtures to flow onto haulage roads and collect in high, unventilated spots.

The pressure gradient was approximately as shown in figure 3.

Air Distribution With Fan A Stopped and Return Blocked

Air flow along the haulage road and at point B was approximately 65 percent of that with both fans operating (see fig. 4). The return entries between fan A and point B were neutral, which reduced the hazard of gas from gob areas reaching the haulage road. The haulage road between section X intake and main junction B had some intake flow. The pressure was not against the gob areas; the bleeder entries, however, would not be effective, and very little air would actually enter the gob. Air would flow along gob fringes to return sources. Sections inby fan B were ventilated by 75,000 c. f. m.

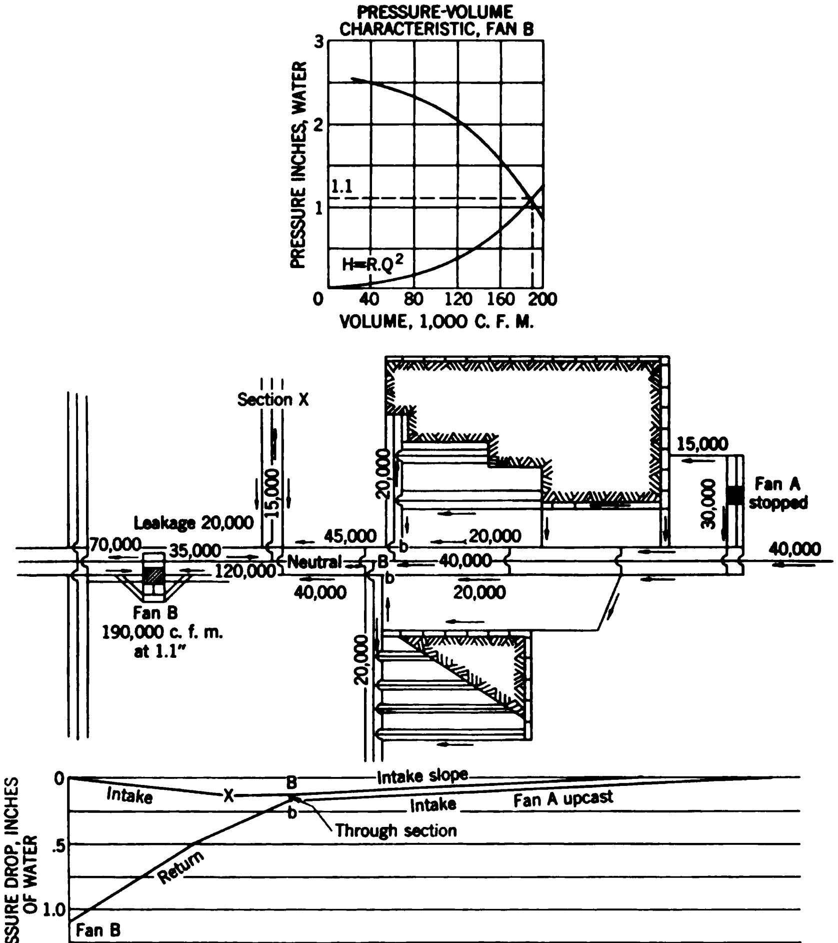

FIGURE 3. - Mine A–Air Distribution With Fan A Stopped.

Discussion

This illustration shows the advantages gained when self-closing doors are installed to block the return sides of airshafts. Such doors constitute the most important single protective measure that can be taken with ventilating systems employing multiple main fans.

MINE B

The mine was ventilated by 3 main fans operated exhausting - fan

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A at 101,000 c. f. m. and 2.20 inches of water pressure, fan B at 191,000 c. f. m. and 1.84 inches of water pressure, and fan C at 94,000 c. f. m. and 1.95 inches of water pressure. Two intakes were provided - a slope and a shaft at fan B.

Figure 5 shows the airflow distribution of mine B under normal operating conditions.

Normal Air Distribution With Two Fans Operating

The air entered through the slope entry and split at the junction of the south and east mains; part of the air traveled the south mains aircourses to ventilate the developing sections at D and E and the pillar section at F; the remainder traveled the east main aircourses to the junction of C section where it combined with intake air from the fan B air shaft to ventilate the developing sections B and C and the pillar section at G.

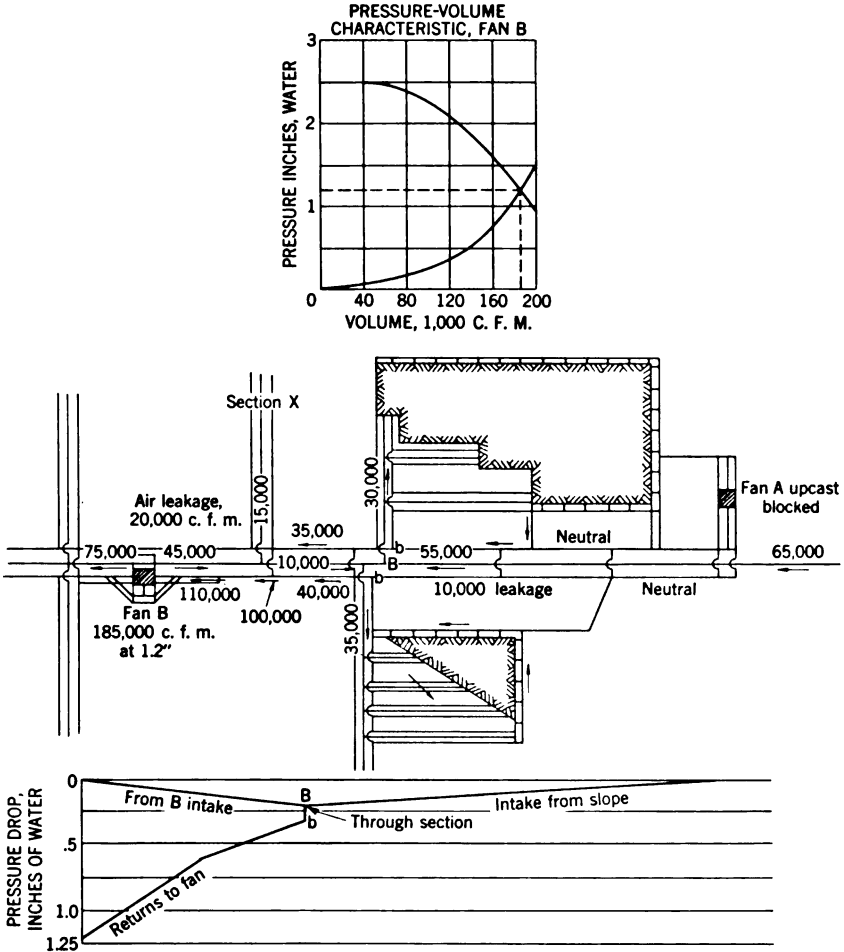

FIGURE 4. - Air Distribution With Fan A Stopped and Return Blocked.

The intake air through the shaft was split at the shaft bottom. One split was used to ventilate the developing section at A and the other split was combined with airflow from the slope entries to ventilate sections B, C, and G.

The return air from active sections off the south mains and from bleeder section G was directed to fan A or C. Doors were not used to separate the return air between each section.

Air from sections B, C, and G was directed to fans A and B. The return air in section G split in the pillared area and again at the junction of the section C and east main returns. The return air from section A was exhausted through fan B.

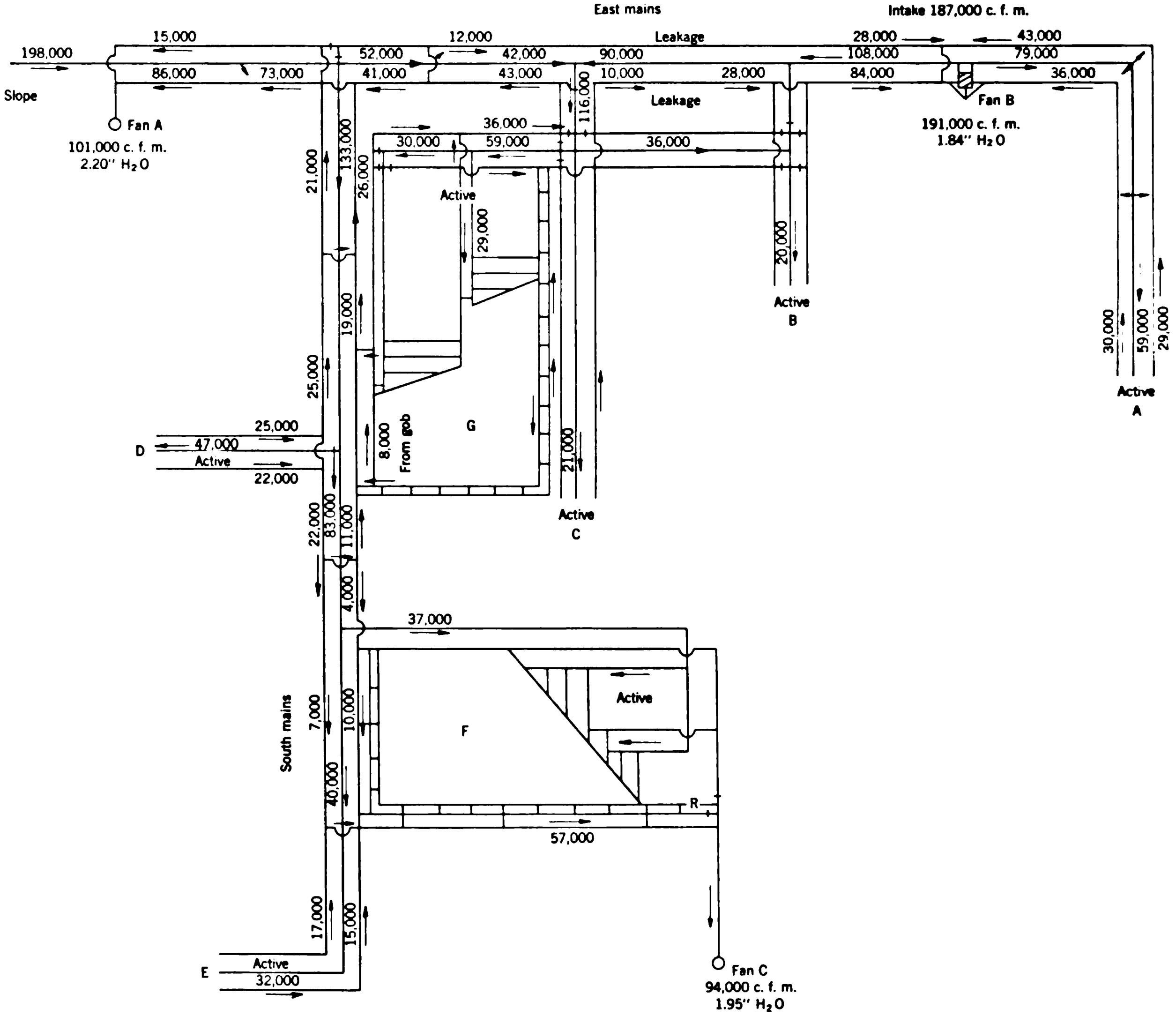

FIGURE 5. - Mine B—Normal Air Distribution With Two Fans Operating.

Air Distribution With Fan B Stopped and Upcast Open

This study shows fan B stopped and the return shaft open to determine the changes this condition imposed on the distribution of mine air (see fig. 6). The notable changes in this study were the reversal of air currents, the redistribution of flow, and the operation of the fans at a reduced pressure.

With fan B stopped the upcast shaft became an air intake, and the faces in sections A and B were ventilated through the returns by air intaking through the upcast shaft; the intake to section A then became a return. The flow in the east mains returns was reversed between sections B and C and the air shaft and junction with south mains. The intake air entering through the

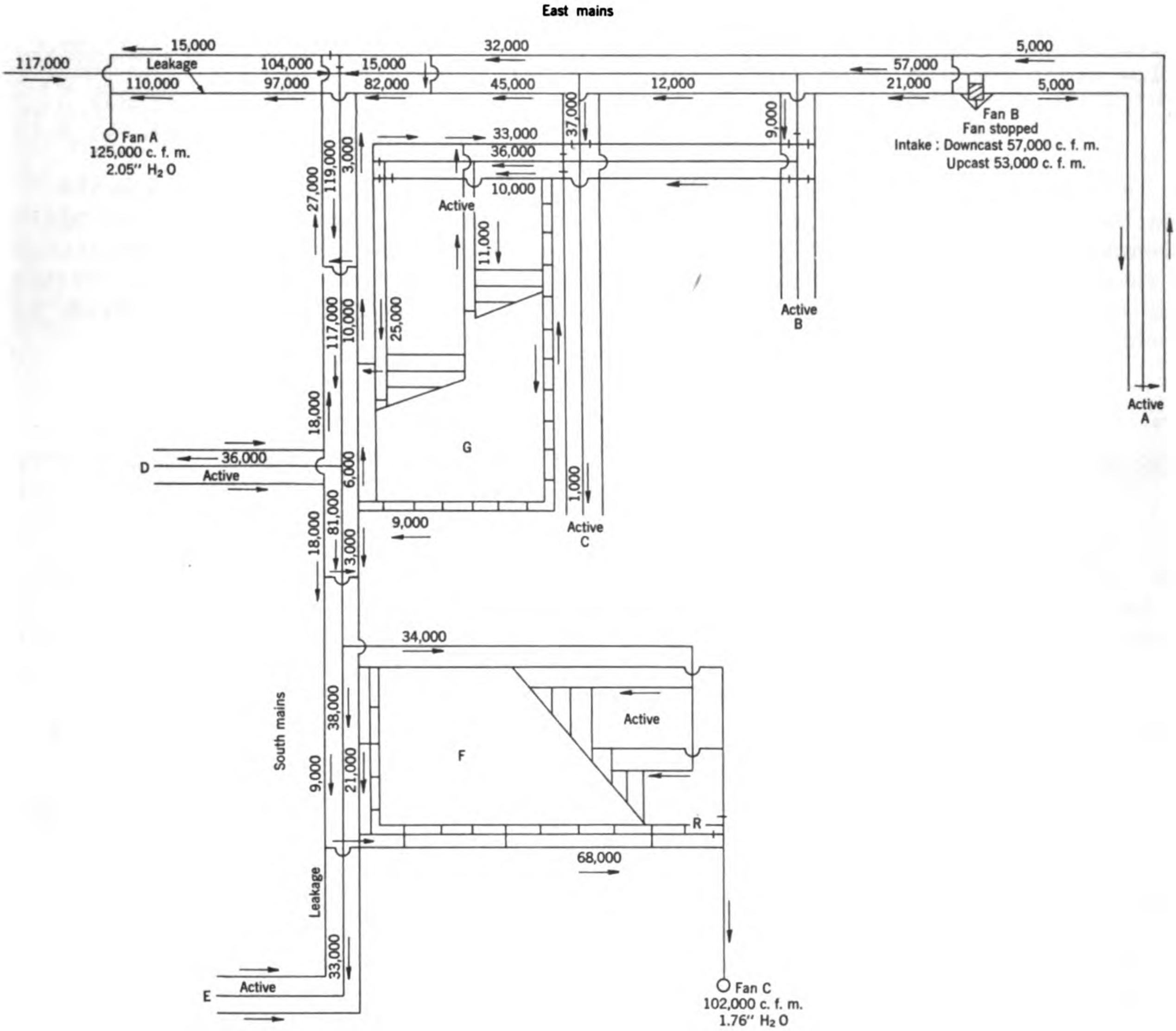

FIGURE 6. - Mine B—Air Distribution With Fan B Stopped and Upcast Open.

shaft ventilated sections C and G at reduced volume and joined the intake from the slope at the south mains junction. Airflow in the south mains and in the sections off the south mains followed the normal distribution pattern.

Reduced mine resistance caused by the redistribution of air splits enabled the fans to operate at a slightly lower pressure with greater quantities of air.

The most serious changes affected by stopping fan B were the reduced airflow available to the pillar section G, which changed from 59,000 to 36,000

c. f. m., and the active sections A, B, and C, which were not properly ventilated or else were ventilated with return air. The reversed direction of airflow along certain returns and intakes was also undesirable.

Air Distribution With Fan B Stopped and Upcast Blocked

A quantity of air reduced from the normal entered the mine through the intake shaft (see fig. 7). This air was split at the shaft bottom; one split ventilated A faces and followed the returns to fan A, and the other split traveled to the intersection with section C, where it was again split. Part of the air passed to the south mains intakes, and the remainder ventilated sections B, C, and G.

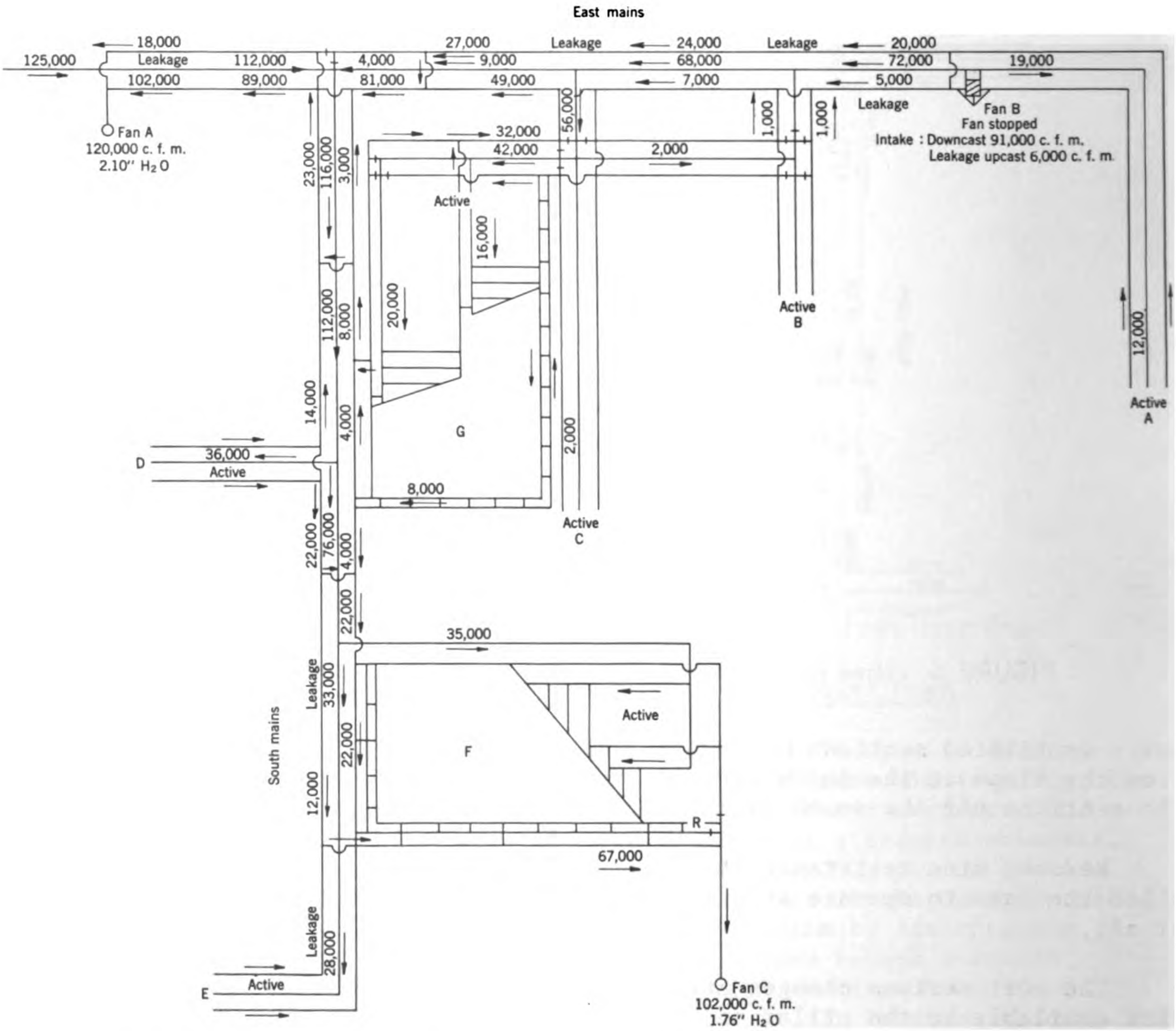

FIGURE 7. - Mine B—Air Distribution With Fan B Stopped and Upcast Blocked.

Very little air reached B and C faces; also, a substantial part of the intake air available for section G was lost by leakage.

Ventilation of sections off the south mains followed the normal distribution of airflow.

The air reversal in certain returns and intakes was the same as in the preceding study; however, section A now was ventilated with 12,000 c. f. m. of intake air, and the intake quantities to section G were increased. Sections B and C were not adequately ventilated in both tests described. The direction of airflow through gobs to bleeders and the return systems did not change.

Air Distribution With Fan A Stopped and Upcast Open

The results were characterized by reversal of airflow, redistribution of air, and fans operating at reduced pressure with increased quantities of air (see fig. 8).

Except for the intake through fan A, distribution was normal. The returns to fan A showed a reversal of flow in the south and east mains. The air that entered through fan A was split at the return junction of the south and east mains and went directly to fans F and C; other than reducing the intake air available to certain sections, distribution was normal.

Except for a reversal of air in certain returns that were not thought to be important, the reduction in quantities of air to sections D, E, and G appears to be the undesirable feature of this ventilation system.

Air Distribution With Fan A Stopped and Upcast Blocked

The flow pattern with this condition (see fig. 9) was similar to that in the preceding study, with fan A stopped and the upcast open. Since the upcast was blocked, only leakage entered the return airways to fan A. Distribution of air in the other circuits was similar to the original system. More intake air was available to section G, but the ventilation of sections D and E was only slightly improved.

Air Distribution With Fan C Stopped and Upcast Open

This condition created several undesirable and some potentially hazardous conditions (see fig. 10); as follows:

Intakes to sections A, B, C, and G, except for reduced quantities of air, were similar to normal airflow. The great difference was in the direction of flow across the gob in section G. The preceding studies showed a pressure drop from the faces across the gob to the bleeders and returns; in this study, however, a flow was indicated from returns into bleeder entries and gobs - a reversal from the previous flow. How potentially serious such a condition could be depends on many factors.

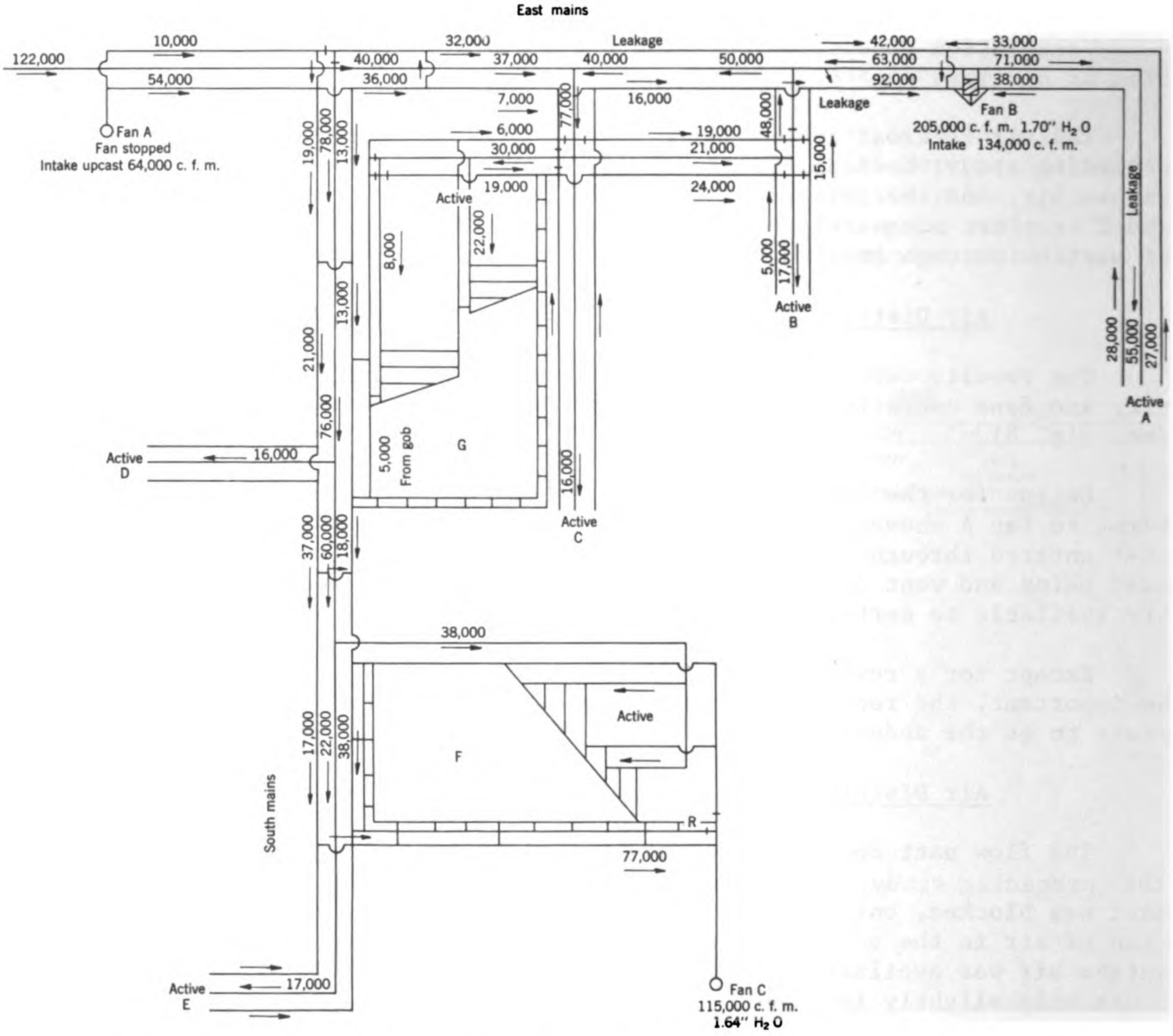

FIGURE 8. - Mine B—Air Distribution With Fan A Stopped and Upcast Open.

Intake air through the fan C airshaft was split at the bottom; part followed the return system, and another part entered the bleeder entries and flowed along the gob fringes to the return system. Some of this air entered the intake system by reversal of air at the faces. The air then combined with intaking air to section E. With this condition section F was not ventilated by intake air, and section E was partly ventilated by return air. The direction of flow in return aircourses inby section D was, of course, reversed.

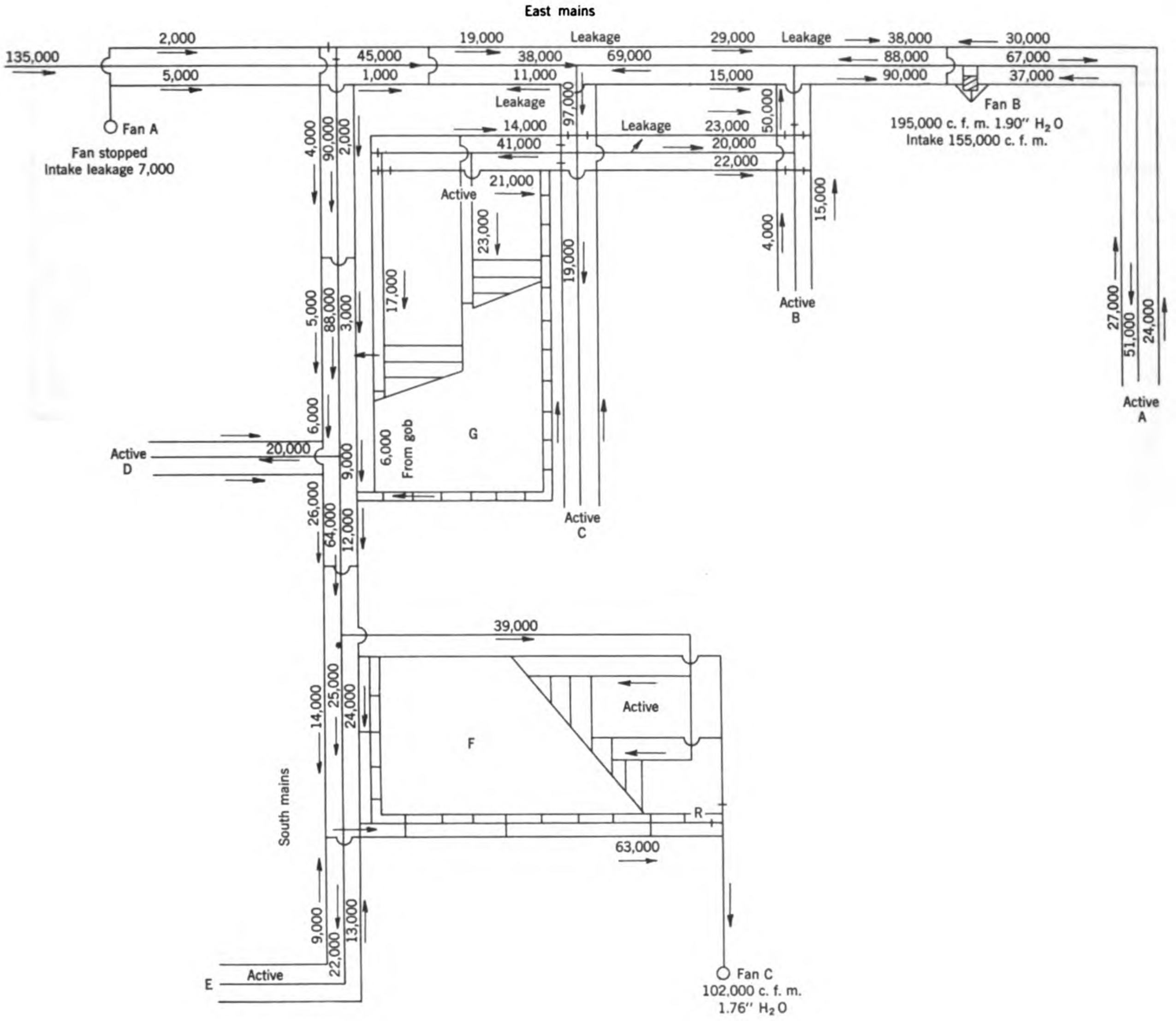

FIGURE 9. - Mine B—Air Distribution With Fan A Stopped and Upcast Blocked.

Air Distribution With Fan C Stopped and Upcast Blocked

Comparing the results of this study (see fig. 11) with the preceding one, in which the upcast served as an intake, indicates several salient differences.

The total air quantity now was 322,000 c. f. m., compared with 329,000 c. f. m.; however, the amount of intake air available was 322,000 c. f. m., compared with 271,000 c. f. m. Sections A, B, C, and D were ventilated as before, with essentially the same quantities of air and conditions. In this study air reversal at the face of section G was not evident; however, a

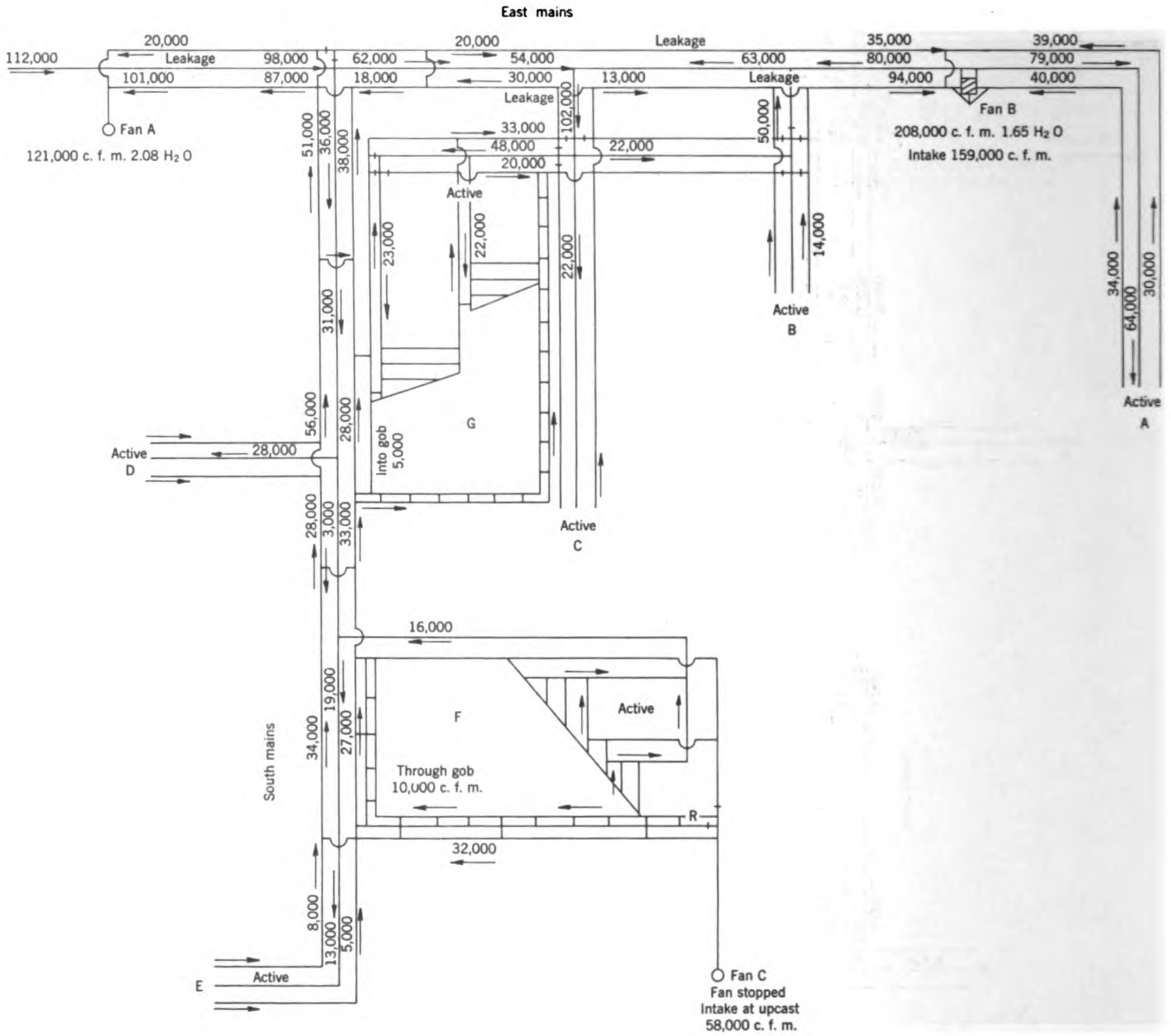

FIGURE 10. - Mine B—Air Distribution With Fan C Stopped and Upcast Open.

pressure differential could exist across the gob as before. Consequently, the potential hazard was not changed. Sections E and F, previously inadequately ventilated, now were ventilated with intake air, which corrected an undesirable condition that existed in the preceding study.

Discussion

These studies of mine B illustrate the varying degrees of influence that individual fans have on the ventilating system.

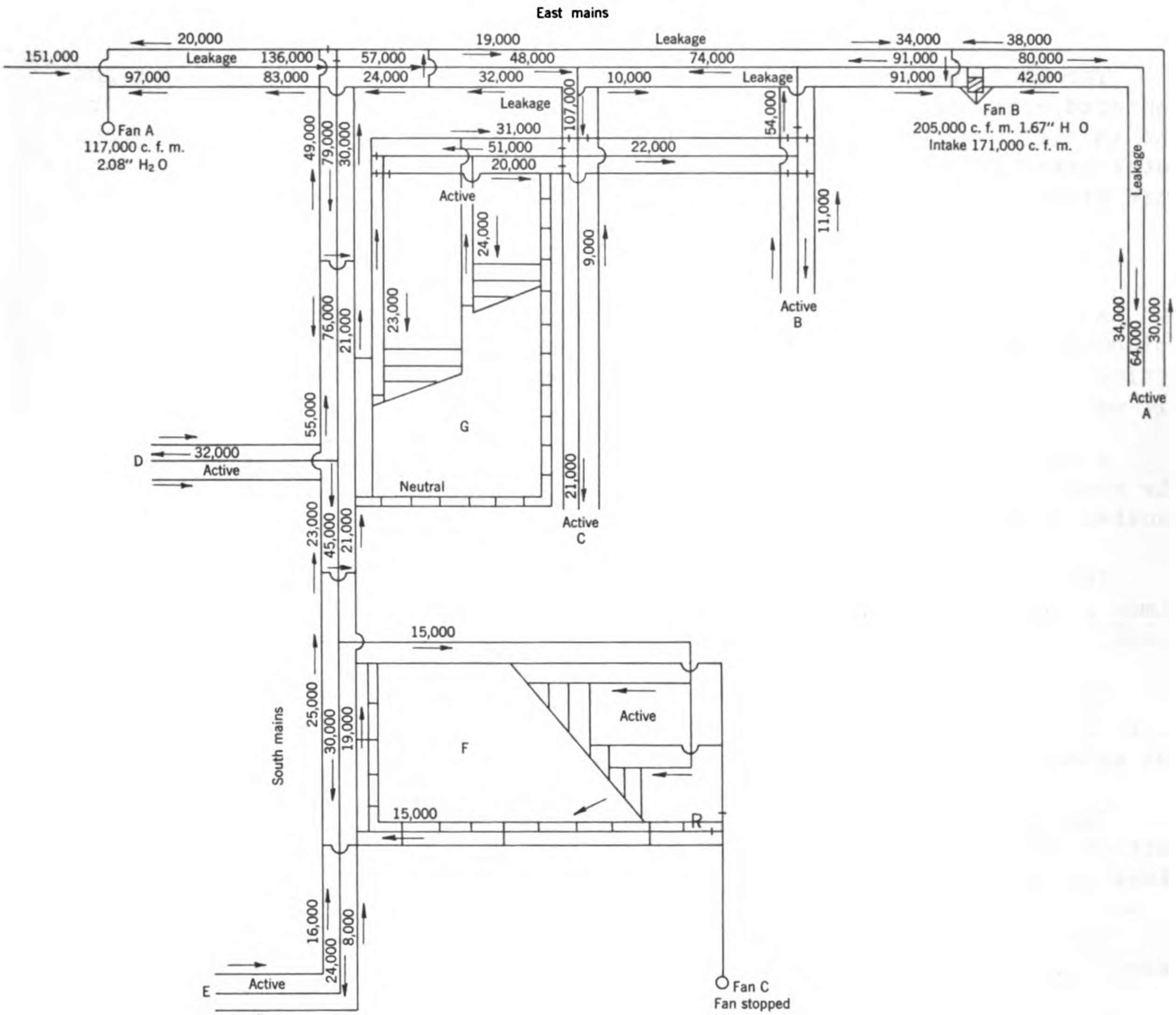

FIGURE 11. - Mine B—Air Distribution With Fan C Stopped and Upcast Blocked.

Failure by fan B caused a redistribution of the pressure-volume balance; however, except for obviously short-circuiting air from developing sections and changing the direction of airflow in certain segments of the system, the seriousness of potential hazards was not great.

Failure by fan A did not create much change in the airflow-distribution pattern other than reducing the quantity of airflow in certain sections.

Failure by fan C influenced a critical balance in the direction of airflow through gobs, working sections, and new development work inby the fan. Endeavoring to continue operations on even a limited scale when this fan stopped could become hazardous.

MINE C

The mine was ventilated by two main fans installed on the surface and operated exhausting - fan A at 308,000 c. f. m., 4.3 inches water pressure, and an air horsepower of 208.5; and fan B at 259,000 c. f. m., 3.35 inches water pressure, and an air horsepower of 136.7. Four separate intake shafts were provided; the mine was large, with extensive, ventilated old workings.

Normal Air Distribution With Two Fans Operating

A total of 99,000 c. f. m. of air entered the mine through shaft C and followed various aircourses to ventilate worked-out areas off 1 east and the active sections A, B, and C, off 2 east mains (see fig. 12). This incoming air was exhausted through fan A.

A total of 34,000 c. f. m. of air entered the mine through shaft D; the air ventilated the worked-out areas off 2, 3, and 4 south mains and was exhausted from the mine at fan A through the returns of 2 east mains.

The air entering the mine at shaft E (124,000 c. f. m.) was split four times to provide ventilation for various haulageways, working sections, and shops.

The 2 east haulage roads were ventilated in part by a split of 35,000 c. f. m.; this air was again split in the 2 east returns, and some of the air was exhausted by each fan.

The split of air traveling 6 south mains (64,000 c. f. m.) combined with part of the air entering the mine through shaft B to ventilate the active portions at F, G, and H. This split of air from shaft E was exhausted by fan B.

The quantity of air entering the mine at shaft B (310,000 c. f. m.) provided two splits of 142,000 c. f. m. and 168,000 c. f. m.

The split of 142,000 c. f. m. ventilated the haulage roads of 2 and 3 south mains and the active part D at 3 south mains. Except for 14,000 c. f. m. returning from section D, this air was exhausted by fan A.

The split of 168,000 c. f. m. provided air for the active sections at E, K, and L, and a portion of the air was used to ventilate the active sections at F, G, and H. Sections K and L were ventilated by a single intake but with returns to both Fans A and B.

Air Distribution With Fan A Stopped and Upcast Open

For this study fan A was stopped and the upcast left open, which served as an additional intake and permitted 27,000 c. f. m. to enter the mine (see fig. 13).

Fan B circulated 289,000 c. f. m. at 3.0 inches of water pressure and 136.5 air horsepower. This increased quantity of air at reduced pressure was due to a change in the airflow pattern.

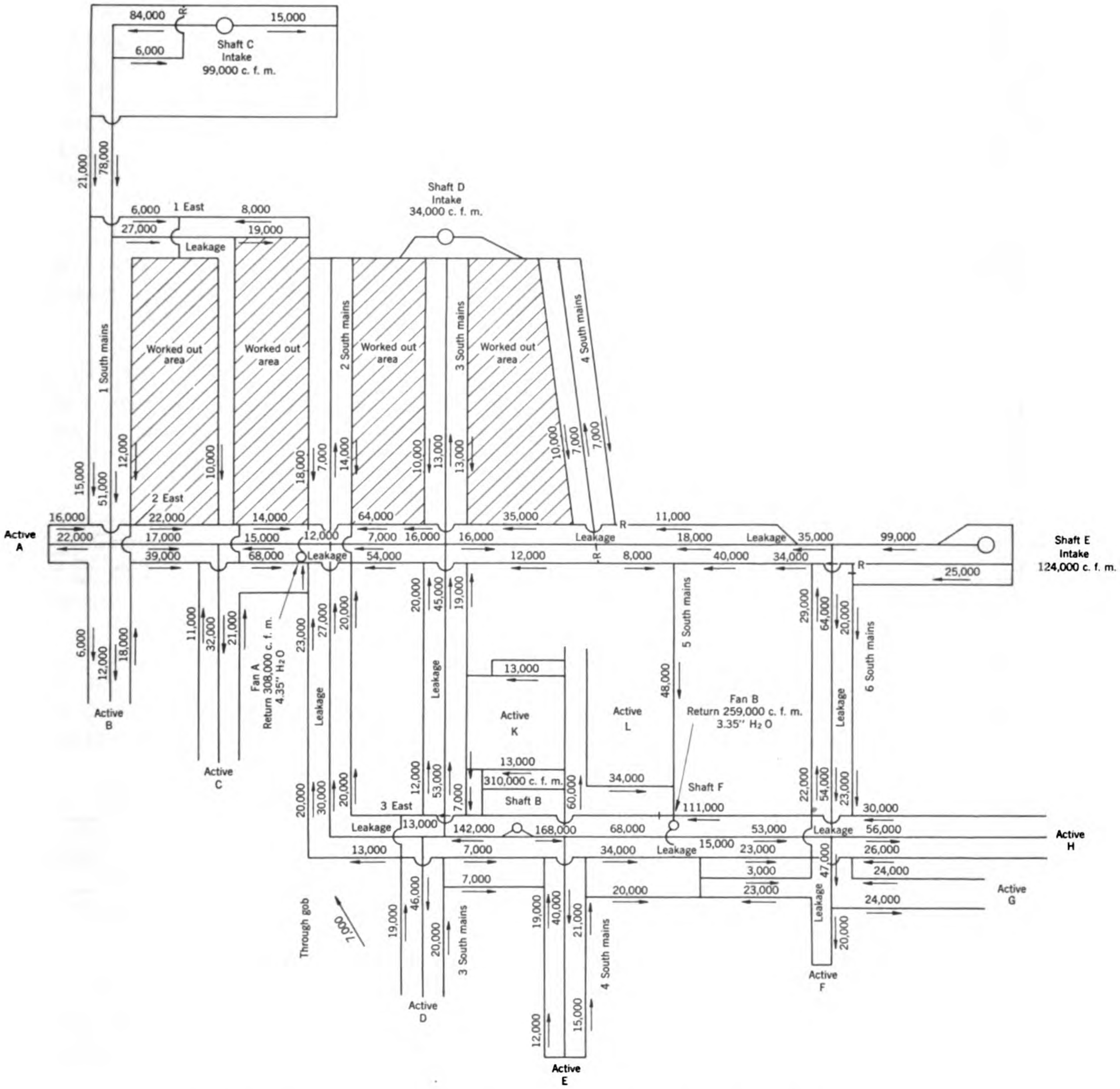

FIGURE 12. - Mine C—Normal Air Distribution With Two Fans Operating.

With fan A stopped air currents were redistributed, air quantities reduced in certain areas, and air currents reversed.

Since the air intake at shafts C and D was influenced by the action of fan A, the intake was now greatly reduced, with a resulting loss of ventilation to the worked-out areas north of 2 east mains and to the working sections at A, B, and C. A neutral zone developed in the airway supplying 3 south mains from 2 east mains, and there was a reversal of flow in 4 south mains from shaft D to 2 east mains.

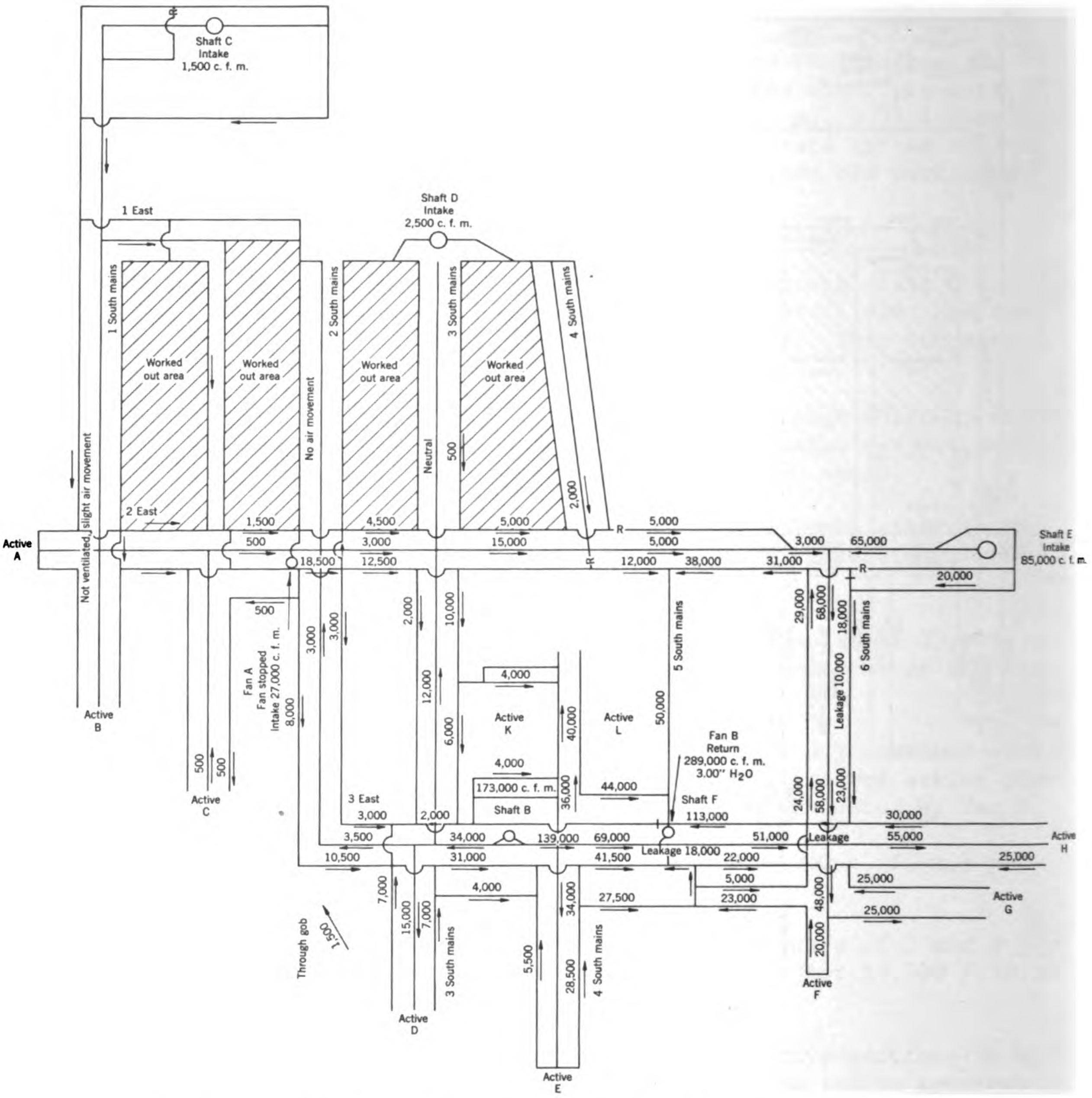

FIGURE 13. - Mine C—Air Distribution With Fan A Stopped and Upcast Open.

The flow through shaft E was reduced from 124,000 to 85,000 c. f. m. A normal quantity of air (20,000 c. f. m.) was supplied to the shops. The remainding 65,000 c. f. m. joined the air from 2 east mains and traveled 6 south mains to combine with air at the 3 east mains junction to ventilate the working sections at F, G, and H. The quantity of air available to those sections was not essentially changed.

The 173,000 c. f. m. of intake air from shaft B was divided into two splits. The main split (139,000 c. f. m.) ventilated sections K, L and E and the 3 east haulage road; the secondary split (34,000 c. f. m.) ventilated section D and the 2 south haulage road. With fan A stopped the airflow in the returns of section K reversed; this caused a flow of return air from 3 south mains through section K to the working faces of section C, which created a potentially hazardous condition.

The 27,000 c. f. m. that entered through the upcast of fan A combined in the return system with flow from shafts C and C. The flow in the returns through 2 and 3 south mains to 3 east from 2 east mains was reversed.

The quantity of air entering the mine at shaft B was reduced from 310,000 to 173,000 c. f. m. The principal airflow change was in the west split, which was reduced from 142,000 to 34,000 c. f. m. This naturally reduced the quantities of air available in sections D and C and along haulage roads.

Air Distribution With Fan A Stopped and Upcast Blocked

For this study fan B was operating at 295,000 c. f. m. at 2.9 inches of water pressure and 134.8 air horsepower. The distribution of air under this condition was as shown in figure 14.

Intake air through shafts C and D, when compared with the preceding study was substantially increased. This permitted some intake air to sections A, B, and C, which were not ventilated during the preceding study, and also improved ventilation in old workings and in 1 south haulage road.

The air intaking through shaft E followed similar airflow patterns shown in the preceding study.

The intake through shaft B was increased from 173,000 to 192,000 c. f. m.; however, this did not greatly improve ventilation in sections D, E, K, and L. The airflow in section K was reversed, as in the preceding study.

This study illustrates that blocking upcast shafts will not solve all problems encountered when 1 of 2 fans stops; however, it greatly benefits ventilation of operating sections, since all airflow is available as intake air rather than air entering return circuits.

Air Distribution With Fan B Stopped and Upcast Open

Fan A exhausted 321,000 c. f. m. at 4.1 inches of water pressure and 207.5 air horsepower, an increase of 13,000 c. f. m. from normal (see fig. 15).

Stopping the fan caused redistribution of air circuits, reduction in quantity of flow in certain sections, and reversal of airflow. The ventilation of certain active sections by return air was also evident.

Air entered shafts C and D at quantities reduced from normal and generally followed the regular distribution pattern.

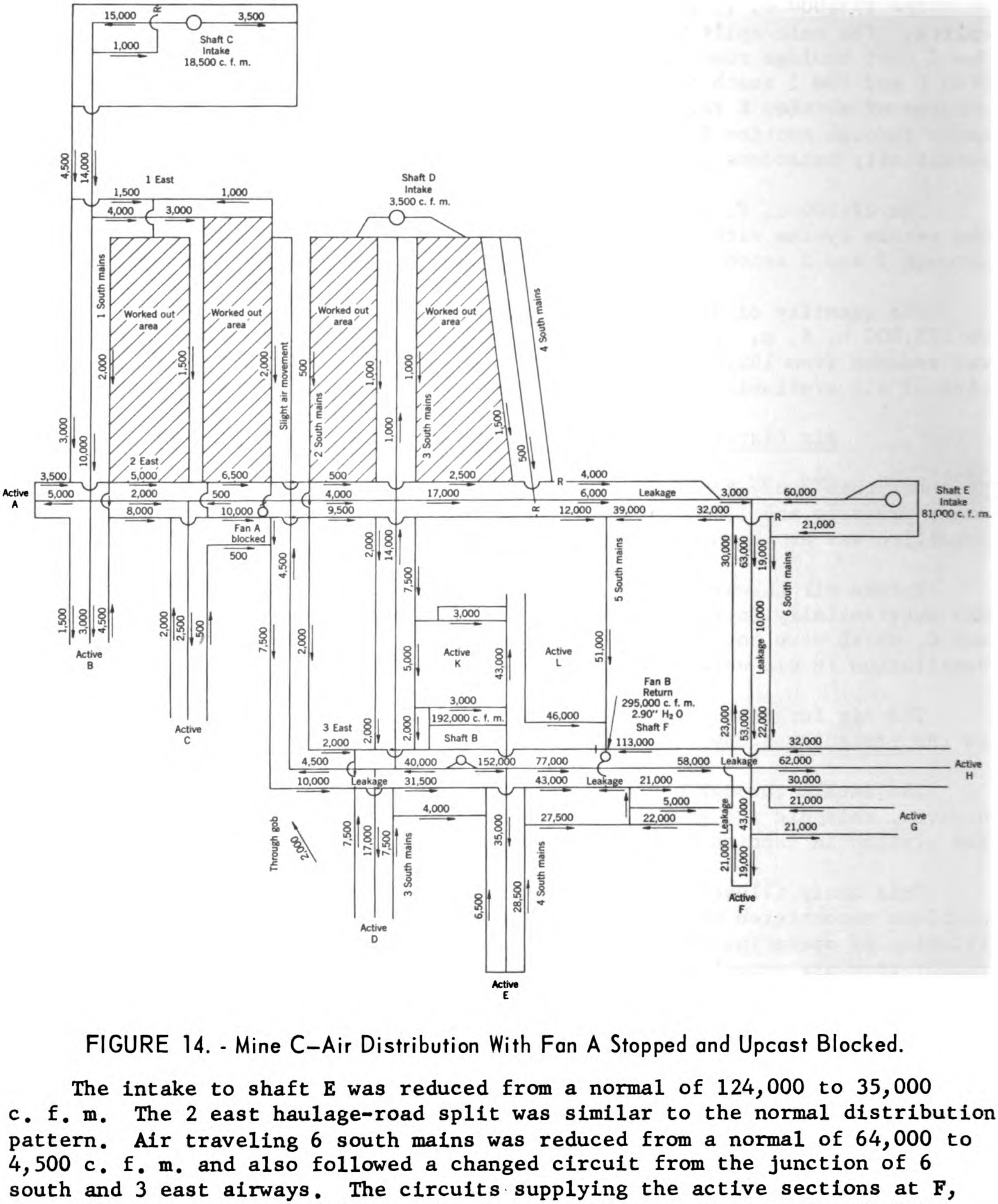

FIGURE 14. - Mine C–Air Distribution With Fan A Stopped and Upcast Blocked.

The intake to shaft E was reduced from a normal of 124,000 to 35,000 c. f. m. The 2 east haulage-road split was similar to the normal distribution pattern. Air traveling 6 south mains was reduced from a normal of 64,000 to 4,500 c. f. m. and also followed a changed circuit from the junction of 6 south and 3 east airways. The circuits supplying the active sections at F, G, and H were reversed, which caused these sections to be ventilated with return air at greatly reduced quantity.

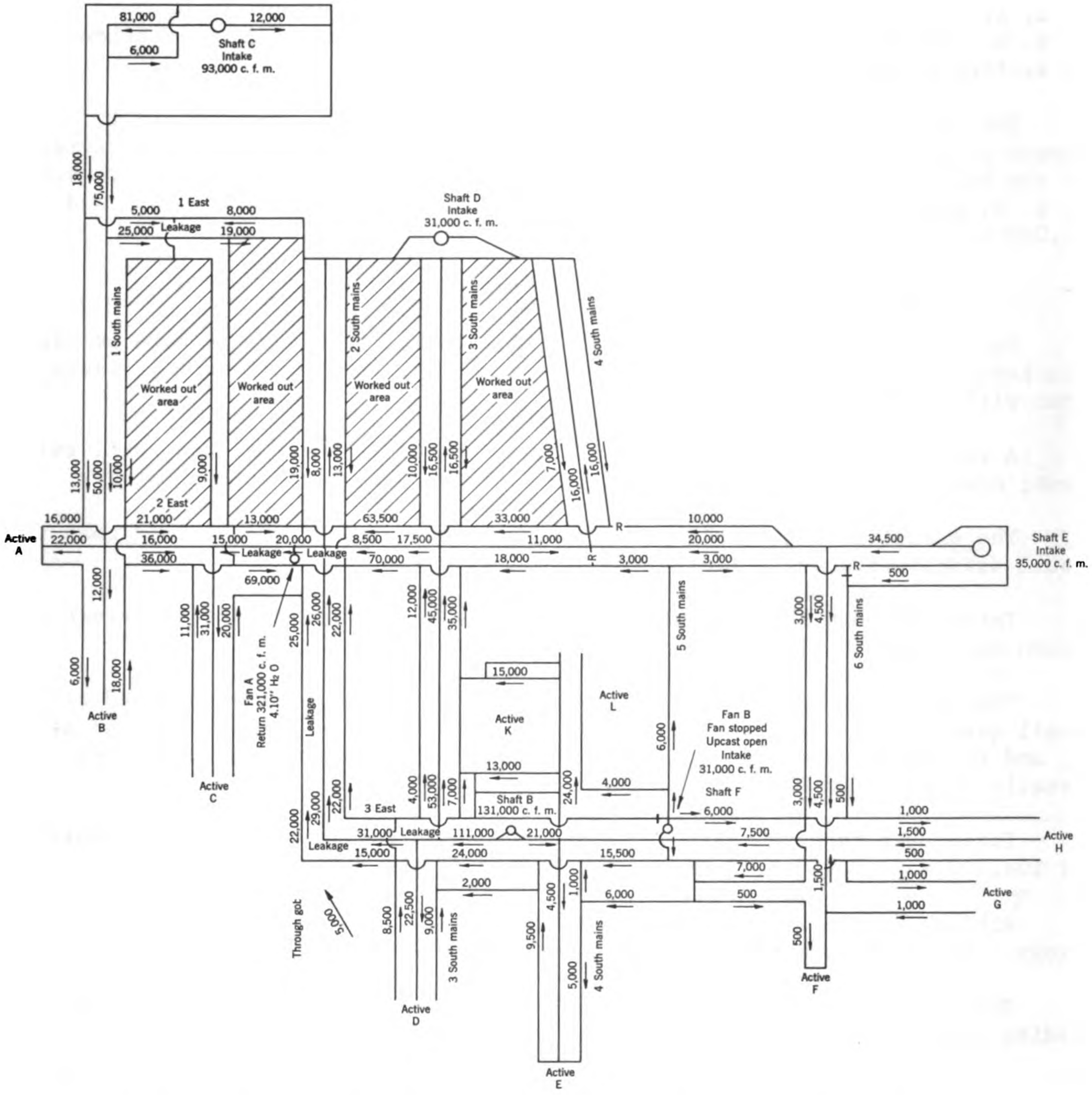

FIGURE 15. - Mine C—Air Distribution With Fan B Stopped and Upcast Open.

The air intake at shaft B was reduced from a normal of 310,000 to 131,000 c. f. m. and was divided into splits of 110,000 and 21,000 at the shaft bottom; the flow along 2 and 3 south haulage roads was similar to the normal flow pattern. The flow to the active section at D was reduced to 22,500 c. f. m.

The other intake split of 21,000 c. f. m. combined with 7,500 c. f. m. of return air from sections G and H in 3 east airways to ventilate the sections at E, K, and L. The quantity of air to section E was reduced to 4,500 c. f. m., the air to sections K and L to 24,000 c. f. m., and the airflow in section L was reversed.

The 31,000 c. f. m. of air intaking through the fan shaft naturally showed a reversal in the returns normally supplying the fan. The air divided at the bottom of the shaft. One split followed the 6 south airways with 4,000 c. f. m. and entered the returns of section L; other splits were 6,000 and 15,000 c. f. m.

Air Distribution With Fan B Stopped and Upcast Blocked

Fan A exhausted 317,000 c. f. m. at 4.2 inches of water pressure at 210 air horsepower (see fig. 16). This was slightly less air and more pressure than with fan B upcast open.

A redistribution of air at quantities reduced from normal was still evident; however, flow definitely improved over that in the preceding study.

The quantities of intake air through shafts C and D were smaller than for usual distribution but followed the normal flow pattern.

Intake through shaft E was 47,000 c. f. m., which was split as before between the 2 east haulage road and 6 south mains.

The air entering 6 south mains was 12,000 c. f. m., which combined with a small quantity of air from 3 east mains to ventilate the active sections at F, G, and H. These sections were ventilated by intake air but at quantities greatly reduced from normal.

Intake air through shaft B was 148,000 c. f. m., divided into two splits of 108,000 and 40,000 c. f. m. at the bottom of the shaft.

Airflow in the 2 and 3 south airways was similar to that in the preceding study. The flow to section D remained at 22,500 c. f. m.

The second split of 40,000 c. f. m., a substantial increase over the preceding study, was too small to ventilate sections E, F, G, H, K, and L.

Airflow in the 3 east returns was substantially reduced from normal with some reversal of air.

Discussion

These studies of mine C illustrate the influence that individual fans have on a ventilating system using several intakes. A study of these data shows how many of the potential hazards listed earlier in this report could develop from a simple fan failure.

Failure of fan A with the upcast open caused sections A, B, and C, the haulage road of 1 south mains, and old workings north of 2 east mains to be

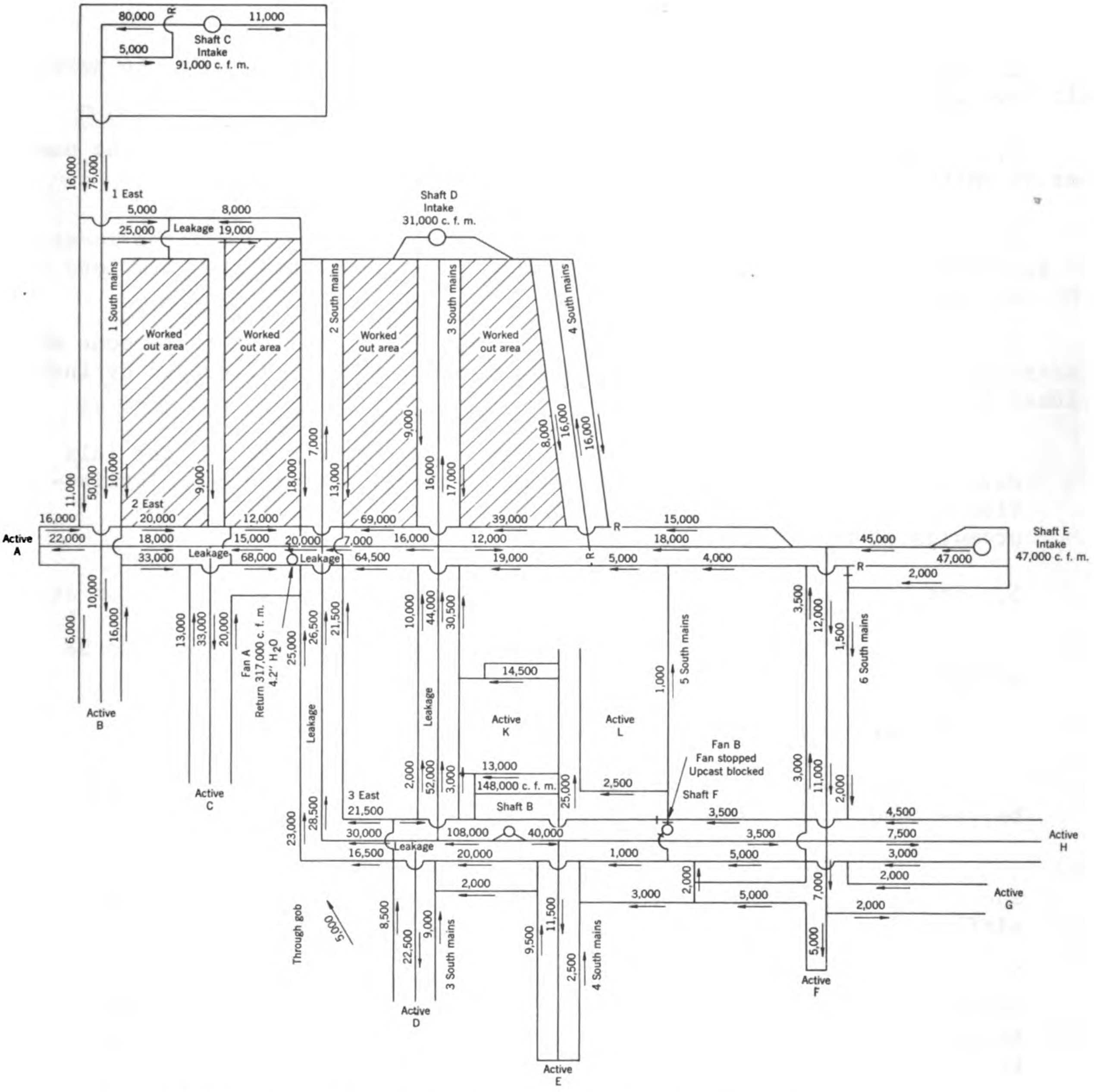

FIGURE 16. - Mine C—Air Distribution With Fan B Stopped and Upcast Blocked.

inadequately ventilated. Reversed airflow in sections K and L illustrated that return air could enter the faces of active working sections.

Failure by fan B created certain undesirable conditions in the working sections - principally in sections E, F, G, and H, where a definite reversal of air from return aircourses to intakes occurred.

RECOMMENDATIONS

1. Self-closing doors should be installed at all return exits to prevent air from intaking in the event of a fan failure.

2. It may be desirable to regulate certain intakes by limiting the number of entries to prevent dead areas in intake aircourses.

3. With self-closing doors the returns should be separated, the location of separation doors determined by the number of sections and the work load of the fan ventilating the area.

4. The responsibility for ventilation should be assigned to someone who understands mine ventilation and knows which sections are influenced by individual fans.

    a. It may be desirable to occasionally stop one fan during idle days and determine by actual measurement of air what the new distribution of air will be; the hazards then can be evaluated and plans promulgated to minimize them.

5. The recommended operating procedure should be followed if a fan stops.

    a. Electric power should be disconnected from areas known to be affected.

    b. Men should be withdrawn from the affected areas.

    c. Doors at the return shaft bottom of the stopped fan should be examined; make certain that they are functioning properly.

    d. If doors are used to separate return aircourses, these should be opened next to connect returns and permit reduced intake airflow through the sections influenced by fan failure.

    e. If the fan remains idle for an extended time, the mine should be examined daily for changing conditions that could become hazardous; haulage roads particularly, as well as sections, should be examined.

    f. After the fan is operating, examine the mine and give particular attention to haulage roads, pump stations, and substations, as well as face areas.

    g. Findings of the examination should be recorded in the State book.

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